CHAPTER 11

FROM THE LOGIC OF SCIENCE TO THE LOGIC OF THE LIVING

The relevance of Charles Peirce to biosemiotics

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Abstract: Biosemiotics belongs to a class of approaches that provide *mental models of life* since it applies some semiotic concepts in the explanation of natural phenomena. Such approaches are typically open to anthropomorphic errors. Usually, the main source of such errors is the excessive vagueness of the semiotic concepts used. If the goal of biosemiotics is to be accepted as a science and not as *a priori* metaphysics, it needs both an appropriate source of the semiotic concepts and a reliable method of adjusting them for biosemiotic use. Charles S. Peirce's philosophy offers a plausible candidate for both these needs. Biosemioticians have adopted not only Peirce's semiotic concepts but also a number of metaphysical ones. It is shown that the application of Peirce's basic semiotic conceptions of sign and sign-process (*semiosis*) at the substantial level of biosemiotics requires the acceptance of certain metaphysical conceptions, i.e. *Tychism* and *Synechism*. Peirce's method of pragmaticism is of great relevance to biosemiotics: 1. Independently of whether Peirce's concepts are used or even applicable at the substantial level of biosemiotics, Peirce's method remains valuable in *making* biosemiotics and especially in adjusting its basic concepts. 2. If Peircean semeiotic or metaphysics is applied at the substantial level of biosemiotics, pragmaticism is valuable in clarifying the meaning and reference of the applied Peircean concepts. As a consequence, some restrictions for the application of Peirce in biosemiotics are considered and the distinction of Peirce's philosophy from the 19th century idealistic *Naturphilosophie* is emphasized

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1. BIOSEMIOTICS AND PEIRCE

1.1. Biosemiotics as a Mental Model of Life

The word 'biosemiotics', being a compound of 'bio' and 'semiotics', refers literally to the union of the studies of (biological) life and signs. Because semiotics is

M. Barbieri (ed.), Introduction to Biosemiotics, 257–282.

understood as a science, study, or doctrine of signs, biosemiotics is often characterized as a 'science of signs in living systems' (e.g. Kull 1999: 386). Semiotic concepts are commonly used, depending on the semiotic tradition, to refer to epistemological, linguistic, psychological, social, or cultural phenomena, i.e. usually to some specifically *human* phenomena. In the tradition of biosemiotics, these concepts (or their modifications) are nevertheless used in reference to non-human or not specifically human living phenomena too. Biological life is seen therefore to be analogous to mental life or to human sociality, notwithstanding the fact that the human mind and sociality are essential parts of the biological life of the human species.

The recognition of an analogy between mind and living nature has produced two kinds of approaches or research strategies, both risky in their own peculiar way. The *naturalized models of mind* focuses on mind and tries to naturalize it. This includes evolutionary psychology, sociobiology, 'neurophilosophy' (Churchland 1989), and a form of evolutionary epistemology which studies scientific progress (EET).[1] They tend to commit *naturalistic fallacies* by using too economical or restrictive explanatory principles resulting in a too simple and distorted picture of the complexity of mental phenomena. The primary problem is not to do with the simplistic character of the models in themselves but with its origins: that this simplicity follows from the insufficient methods behind its construction —or from some *a priori* decided physicalistic principles (cf. Barbieri: Editorial, this volume)— and *not* from the studied reality itself.

While naturalistic models of mind pursue often a somewhat reductionistic strategy, the other kinds of approaches, the *mental models of life* —to which biosemiotics belongs—pursue typically a holistic strategy. They focus on natural phenomena and try to model them on concepts that originally referred only to the human mental or social sphere. Consequently, they fall easily into *anthropomorphic fallacies* by predicating properties or qualities exclusive to humans to non-human natural phenomena. The outcomes of such fallacies are either simply *false* descriptions or, (more commonly) so utterly vague sketchings that it is extremely difficult or impossible to judge their validity and other than their moral, religious, ideological, or emotional significance.

Anthropomorphisms *per se* are not avoidable — not even in the extreme naturalistic or physicalistic studies. *All* our concepts, even the ones of mainstream physics, can be argued to have their origin in anthropomorphic metaphors or analogies, many of them ultimately rooted in the aspects of our bodily self-experience (cf. Lakoff & Johnson 1980). Metaphorical *origins* of scientific concepts are not problematic, but when these concepts are *abstracted* and *redefined* for scientific purposes, anthropomorphic errors may arise. The chief problem is how to identify and recognize these anthropomorphic errors, i.e. the illegitimate uses of such redefined concepts that are insufficiently, incompletely, or erroneously *abstracted.*

Besides biosemiotics, also an evolutionary epistemology which studies cognitive mechanisms (EEM) and the *Naturphilosophie* of the 19th century German idealism provide mental models of life. In all of these fields, some kind of continuity (even

if only in the form of gradual steps) between non-human biological life and human mental (i.e. logical, psychical, social, or 'spiritual') life is assumed. The forms of mind and sign processes that one can find in biological life are often assumed to be somewhat more primitive, simple, or general than that found in our own minds. However, these three approaches differ from each other in other respects. For example, while Schelling's *Naturphilosophie* (Schelling 1984, orig. 1804) appeals to transcendental arguments *a priori* in its reasoning, the evolutionary epistemologies of Donald T. Campbell (1974, 1997) and Konrad Lorenz (1973) aim to *naturalize* the concepts of knowledge and knowing when generalizing and abstracting them and extending their domain of reference into the animal world and even further. The basic explanatory scheme in evolutionary epistemology is the (Neo)-Darwinian conception of natural selection.[2]

The longing for an all-inclusive metaphysical vision that would experientially unite the nature of man with the nature of his/her environment, and a desire for more narrowly scientific and naturalistic biosemiotic theories have both been present in biosemiotic literature, and are presumably visible also in this volume. Quite often, the tension between these somewhat divergent forces can be found under the surface of biosemiotic discourse and practices — the actual degree of biosemioticians' self-awareness about the motives and purposes of their making biosemiotics evidently varies. I have argued elsewhere (Vehkavaara 2002, 2003) that if biosemiotics is made as a science, it has to be practiced through certain kinds of naturalistic methods, not necessarily (or hopefully) of a physicalistic, reductionistic, or computational kind. The adopted semiotic concepts have to be abstracted, extended, and adjusted appropriately for biosemiotic use so that the used semiotic or mentalist concepts are first naturalized, operationalized, or formalized before they are applied in biology. However, such naturalistic biosemiotics faces the double risk, i.e. committing both naturalistic and anthropomorphic fallacies at the same time.[3] In any case, biosemiotics have to find appropriate and legitimate *methods* of redefining the semiotic or mental concepts it uses in describing living phenomena (cf. Barbieri: Editorial, this volume). Still, there is a great disagreement among the biosemioticians over what the correct standards of such legitimation are.

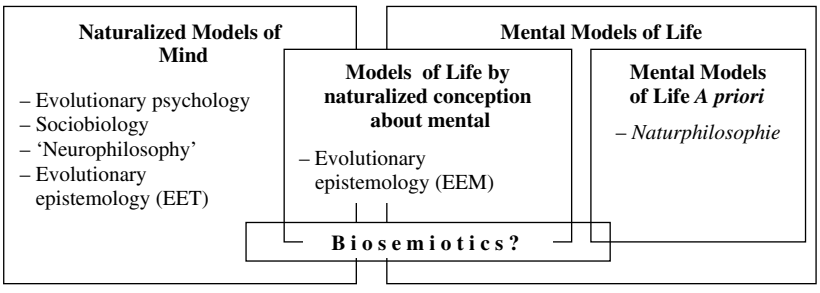

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Figure 1. Scientific approaches based on the analogy between mind and life

1.2. Dynamical vs. Structural Approaches

The semiotic or mental concepts applied in biosemiotics have been appropriated from various sources, not only from the traditions of semiotics, but also from hermeneutics, semantics, linguistics, psychology, and from ordinary common sense, i.e. from 'folk psychology' or 'folk biology'. That tradition of biosemiotics which has first recognized and named itself as biosemiotics, as put forward by Thomas Sebeok (1963) and 'microbiologisized' later by Jesper Hoffmeyer and Claus Emmeche (Hoffmeyer & Emmeche 1991; Emmeche & Hoffmeyer 1991; Hoffmeyer 1993) has followed the semiotic tradition originated by Charles S. Peirce (1839–1914).[4] Why has Peirce been chosen in this 'Copenhagen-Tartu school of biosemiotics' as a point of departure rather than the other major founding father of semiotics, Ferdinand de Saussure (1857–1913)? The reasons (or causes) are probably at least partly accidental, i.e. partly due to the intellectual developments and milieu of the thinking of Sebeok, Hoffmeyer, and other dominant figures. Nevertheless, some substantial reasons can be found too.

Perhaps the most striking difference between Saussure's *semiology* and Peirce's *semeiotic*[5] is that Saussure emphasized the role of the static *synchronic* system of signs (*langue*) and defined his signs as having the *dual* character of *signifié* and *signifiant* (i.e. signifier and signified). Saussure centered on social linguistic communication, i.e. how *individual* psychical meanings become *socially* shared and communicated through speech. Saussure's prototype for the concept of sign was *speech*, the uttered (and heard) phoneme, word, sentence, message, etc. (Saussure 1919).

Peirce's starting point, in turn, was human cognition or cognition in general (ability to learn and investigate), how and when the increase in knowledge is possible. For him, the prototype of sign was *thought*, a thought as a *representation*. Peirce concentrated on dynamic sign *processes* (*semiosis*) and defined his concept of sign as an irreducibly triadic composition of a *representamen*, its *object*, and its *interpretant*.[6] The *irreducibility* of this triadic composition means that its three components have no identity *as* an object, representamen, and interpretant independently of the whole sign they are part of. To put it simply, when a (*first*) thing or event is cognized as a *representamen* of some sign, it is recognized as referring to *another* (*second*) thing or event, the *object* of that sign.[7] This act of recognition is

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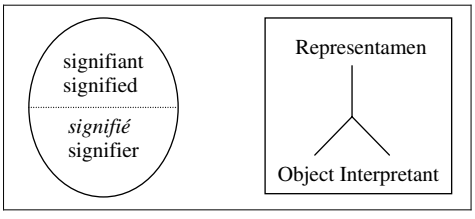

Figure 2. Basic forms of Saussurean and Peircean conceptions of sign

manifested by the *production* of a *third* thing or event in the mind of a recognizer, the *interpretant* of the sign.

In its creation as an interpretation of the representamen, the interpretant gains a *potentiality* to function as another sign of the same object. And if this potentiality is actualized, i.e. the interpretant is actually thought as the thought-*sign*, it will obtain another interpretant that will in turn function as a new thought-sign and so forth potentially *ad infinitum*. A whole chain of signs follows from a singular recognition of a sign in temporal order (CP 2.228, c.1897). This process is called *semiosis*.

The unique character of *semiosis* is that it tends to be a *progressive* process. New signs in the chain expose piecemeal the whole information content about the object that the original representamen contained more or less hidden. In principle, there is an obvious limit to this increase, a limit that may but need not be actually reached. The ultimate end of the series, its *final logical interpretant,* is the *full* embodied conception about the object, the conception that exhibits the whole cognitive content mediated by the sign. There is nothing more to add to this final interpretant, it does not receive a new interpretant anymore and therefore it does not have the nature of sign. Instead, it appears as an undeniable or self-evident *belief*, as a *habit of action*,[8] the habit that is *informed* about the object via the chain of signs. Thus, the Peircean conception of *semiosis* provides a theory or an analysis of how new habits can be adopted, or the old habits can be modified. It is a theory or a description of a rational learning process or gathering of information, a process of *self-controlled habit-formation*. (EP 2:418, 1907.)

It is said that the central task of biosemiotics is to introduce some concept of *meaning* into biology (e.g., Barbieri, 2002, and Editorial, this volume). In Saussure's semiology, meanings become determined merely as differences within the synchronic system of signs, i.e. they are identified only as differences between the meanings expressible in the system. The structuralist approaches, having kinship with (and the origin in) Saussure's semiology, fit best to such biosemiotic applications where biological meanings are considered as the stable ready-made possibilities of material objects or structures. The best biosemiotic example is the case of

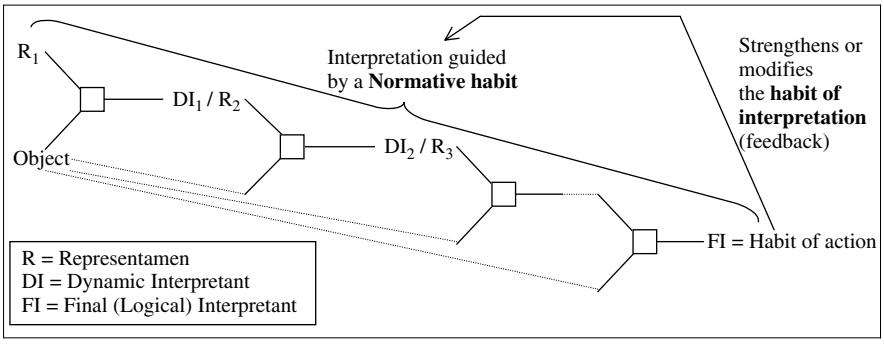

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Figure 3. The chain of signs in Peircean conception of *semiosis*

genetic code where basic amino acids are defined as the meanings of corresponding codons.[9] The question of a biosemiotic structuralist would be: What is the semiotic structure to which the organism or other biosystem conforms?

However, if the focus shifts to the *processes* of life, a different question must be asked, namely: How do organisms *change* their structures (or their environments)? And the biological world is full of many kinds of processes: phylogenesis, ontogenesis, conditioning and other forms of learning, protein synthesis, photosynthesis, gaining the resistance to diseases, nest building, etc. Some of them are unique or even potentially endless (e.g. phylogenesis) and others common and infinitely repeated (e.g. protein synthesis). Moreover, it can be argued that living beings, both organisms and their organizations (like ecosystems), do not merely participate in various processes of life but that they are *ontologically* processes rather than 'things' or static structures. Living systems are dissipative systems, thermodynamically far from equilibrium and therefore they have to maintain themselves continuously by their own action if they are going to preserve their stability and identity (cf. Vehkavaara 2003, Bickhard 1998). If the attention in biosemiotics is paid to the regularities of processes rather than to the ones of the structures, a Peircean dynamic approach may appear a more promising starting point than structural ones.

1.3. Peirce and Semeiotic as Logic

Charles Sanders Peirce was born in 1839 as the son of Benjamin Peirce, the leading mathematician in the USA and a professor of mathematics in Harvard. From his early childhood, he became acquainted with scientific community and under his father's guidance and support, he got the best available education in mathematics, philosophy, and sciences (especially in chemistry, astronomy, and biology). Peirce was trained to become a mathematical natural scientist and he earned his living for over 30 years as an experimental physicist.[10] Although he studied and published in the various fields of mathematics, chemistry, geodesy, metrology, astronomy (stellar spectroscopy), cartography, psychology, and history of science, Peirce's significance is evidently the greatest when it comes to his *theoretical philosophy*, i.e. to his logic and metaphysics. Peirce himself thought logic as the science where his greatest expertise is and his most durable achievements stand (Fisch 1982, xxiii and Brent 1998, 38–39). Peirce describes his intellectual development and character with the following modesty:

> From the moment when I could think at all, until now, about forty years, I have been diligently and incessantly occupied with the study of methods [of] inquiry, both those which have been and are pursued and those which ought to be pursued. For ten years before this study began, I had been in training in the chemical laboratory. I was thoroughly grounded not only in all that was then known of physics and chemistry, but also in the way in which those who were successfully advancing knowledge proceeded. I have paid the most attention to the methods of the most exact sciences, have intimately communed with some of the greatest minds of our times in physical science, and have myself made positive contributions — none of them of any very great importance, perhaps — in mathematics, gravitation, optics,

> chemistry, astronomy, etc. I am saturated, through and through, with the spirit of the physical sciences. I have been a great student of logic, having read everything of any importance on the subject, devoting a great deal of time to medieval thought, without neglecting the works of the Greeks, the English, the Germans, the French, etc., and have produced systems of my own both in deductive and in inductive logic. In metaphysics, my training has been less systematic; yet I have read and deeply pondered upon all the main systems, never being satisfied until I was able to think about them as their own advocates thought. (CP 1.3, c.1897.)

Peirce is perhaps best known as one of the originators of modern formal logic, of semiotics, and of the first originally American philosophical school, *pragmatism.* Though much of his logical studies falls under current mathematical logic, for Peirce, logic was principally a philosophical science.[11] Peirce included both his *semeiotic* and his version of pragmatism in the science of logic. Traditionally, logic has been vaguely defined as an *art of reasoning* (cf. EP 2:11, 1895) but Peirce wanted to develop logic as a *science* of reasoning that provides *theories* about (the art of) reasoning (e.g. EP 2:30, 1898). More specifically, Peirce defined logic as the science of *deliberate* or *self-controlled thought*.[12] The special character of logic —that distinguishes it from metaphysics and cognitive psychology as well as from mathematics— is its normativity. Logic was defined as a *normative* science of thought, a science that provides criteria for the goodness or badness of thought, i.e. similar to ethics that functions as a normative science of *action*. The *semiosis* is described as a *self-normative* process, where the continuous comparison of the changing representamens with the object directs the sign-process internally — no external authority, normativity, or criterion is needed.

Peirce's conception that the emerging modern logic should be expressed in terms of general semiotic, is based on his argument that *all thought is mediated by signs*.[13] He had a number of reasons to think that thought and signs are intertwined. Firstly, the peculiar character of signs was *defined* to be exactly their ability to mediate thought or meaning. Secondly, Peirce insisted that only *embodied* thoughts can be considered and that the embodiment of thought is a sign (EP 2:256, 1903). Thirdly, from the very beginning of his philosophy, Peirce opposed all forms of foundational intuitionism. He forcefully argued that no intuition, no more sensuous than intellectual, could guarantee an unconditionally or absolutely certain foundation for knowledge. If all 'intuition', i.e. direct or non-mediated reference to the object of thought, is impossible, as Peirce argued, all thought have to be mediated by signs (cf. CP 5.213–215, 251–253, 1868).

2. HOW PEIRCE'S SEMEIOTIC CAN BE APPLIED IN METAPHYSICS AND BIOSEMIOTICS

2.1. From Logic to Metaphysics

Presumably, Peirce was originally studied by biosemioticians because of his *semeiotic*, but it seems that his metaphysical insights (and the metaphysical reading of his *semeiotic*) have inspired more influentially the biosemioticians of the Copenhagen-Tartu school.[14] The Peircean concept of sign and scheme of *semiosis*

are nevertheless primarily *logical* conceptions, the prototype of *semiosis* is clearly an *inquiry* or the *scientific* process of investigation.[15] How could such scheme of *semiosis* be applicable also in *natural processes* that seem to be —at least on the surface— of a quite different nature? Would not such an attempt lead to some apparent anthropomorphic error? As a normative science of thought, logic *per se* cannot take into account where its concepts are applied but they need to get firstly a metaphysical interpretation that can be further applied in different special processes of life. Can such application escape being in its heart just one more *a priori* system of rationalistic metaphysics, comparable with the ones of Descartes, Leibniz, Spinoza, Wolff, Hegel, and Schelling?

Part of the fascination of Peirce's metaphysics is that it includes elements that can be applied —or abused— by both those who are attracted to the transcendental argumentation of *a priori* philosophy and those who are more naturalistically minded. It seems to fulfil both underlying intellectual needs of biosemioticians: a longing for an *experientially* understood metaphysical union of man and nature as well as a need for an *experimentally* relevant (and justified) biosemiotic theory. Two questions need to be answered:

1. How can Peirce's theory of rational inquiry be thought to be applicable in modelling the natural processes of life?
2. Can such application be something more relevant than just one more *a priori* system of metaphysics?

2.2. Chance and Continuity

In the second half of the 19th century, the main rivals in metaphysics were the naïve mechanistic materialism of classical positivism and the teleological determinism of absolute or religious idealism. Peirce rejected both the mechanistic and teleological doctrines of inevitable predestination, instead, he proposed a hypothesis that *pure chance* is a real force in nature. This notion that absolute chance is a factor of the universe Peirce called *Tychism* (CP 6.201, 1898). That nature has the element of unpredictable spontaneity, does not nevertheless mean that there would not be real regularities or *laws* of nature too.[16] The regularity of phenomena is not denied but the assumption of the exactitude and absoluteness of natural laws is seen unjustified. At least, there can not be any empirical evidence for that:

> Those observations which are generally adduced in favor of mechanical causation simply prove that there is an element of regularity in nature, and have no bearing whatever upon the question of whether such regularity is exact and universal or not. Nay, in regard to this *exactitude*, all observation is directly *opposed* to it; and the most that can be said is that a good deal of this observation can be explained away. Try to verify any law of nature, and you will find that the more precise your observations, the more certain they will be to show irregular departures from the law. We are accustomed to ascribe these, and I do not say wrongly, to errors of observation; yet we cannot usually account for such errors in any antecedently probable way. Trace their causes back far enough and you will be forced to admit they are always due to arbitrary determination, or chance. (CP 6.46, 1892.)

Peirce's rejection of mechanical determinism is thus based partly on his experience as an experimental scientist and specifically on his awareness about the limitations of the *methods* of experimentation and statistical generalizing. The deterministic demand on the exactitude of natural laws is judged as a mere *a priori* assumption, but if it is not assumed *a priori*, the observed inexactitude of laws can be accepted to be partly due to their very nature as well. This is the doctrine of *Synechism,* which is the most characteristic feature of Peirce's evolutionary metaphysics and of which Tychism is only a corollary (CP 8.252, 1897). It accepts "that being is a matter of more or less", that there is *real vagueness* in nature, i.e. vagueness that is not due to our unclear conceptions and imperfect knowledge. As a regulative principle of logic, it refers to "the tendency to regard everything as continuous" (CP 7.565, 1892)[17] and the reasons to accept it also as a metaphysical doctrine are logical as well. According to Peirce, the atomistic assumption that the nature is a composition of in principle inexplicable ultimate parts leads to the pernicious expectance that the perfect and complete knowledge is in principle achievable. Synechism, in turn, "amounts to the principle that inexplicabilities are not to be considered as possible explanations." (CP 6.173, 1902.) The synechistic hypothesis makes it possible to conjoin law and chance, scientific realism and Tychism. It is a matter of science to study which part of all observed inexactitudes and irregularities are due to our cognitive insufficiency and which part to *real vagueness*.

Although some of Peirce's arguments for Tychism, Synechism, and his other metaphysical hypotheses can no more be judged so forcing as before, the general world view that they draw has become more easily acceptable in the light of the contemporary theories of chaos, dynamic systems, self-organization, and catastrophe than before these mathematical theories were known. The origin of Tychism and Synechism are, however, in those achievements in the science of 1850's —most notably the statistical mechanics (of gases) and Darwinian evolution— that exploited or included the assumption about influential chance. Especially in Darwinian evolution, all the *novelties* come from spontaneous, 'random' variation.[18] But the possibility of the reality of such spontaneity was denied by the Newtonian deterministic world view. As hypotheses, Tychism and Synechism were created to fill that gap. They were *not* intended to legitimate the appealing to miracles as an explanatory principle,[19] but to participate in the general explanation of observed regularities, moreover, of the apparent *novelties* and the *increase* in complexity and diversity in nature:

> But my hypothesis of spontaneity does explain irregularity, in a certain sense; that is, it explains the general fact of irregularity, though not, of course, what each lawless event is to be. At the same time, by thus loosening the bond of necessity, it gives room for the influence of another kind of causation, such as seems to be operative in the mind in the formation of associations, and enables us to understand how the uniformity of nature could have been brought about. (CP 6.60, 1892)

The acceptance of Tychism (or some other equivalent rejection of determinism) is vital for biosemiotics, and especially for such biosemiotics that strives to apply Peirce's semeiotic. In the deterministic world where no genuine choices are possible,

whatever is called meaning or meaningful would not have any significance *as* meaning — meanings would be reduced to mere epiphenomena. Only in the world equipped with genuine choices, there is any sense in talking about the success or failure of interpretation — if there were no possibility to err (or to avoid errors), the sign processes would not have their distinctive character. Some amount of freedom or indeterminacy is a prerequisite for any genuine normativity required by *semiosis*. Thus, the acceptance of Tychism opens up the *possibility* of applying semeiotic in natural processes without dictating to what extent it is possible.[20]

Even if it may look at first glance that natural processes and mental processes are of totally different kinds, this glance may prove to be an illusion due to our too concrete and biased level of consideration. If the concept of mind or thought is abstracted far enough[21] so that only the joint features of natural and mental processes are left in its redefinition, then the logical concepts of sign and *semiosis* may be applicable both in the psychical processes of rational thought and in *some* natural processes. The task of biosemiotics is firstly to make such abstraction and redefinition of its basic concepts and then to study which natural processes are semiotic in nature and which ones are not (or to what extent they are semiotic). Still, the self-critical task of biosemiotics is not to be forgotten, the task to detect anthropomorphic errors in its own argumentation and concepts.

2.3. Making Biosemiotics and Peirce

Biosemioticians have adopted some concepts, ideas, and slogans from Peirce's semiotic and metaphysical writings and proposed that they are applicable in the theories about cognition and mutual communication of animals, prokaryotes, plants, and even intracellular communication. However, it is still an open question whether this kind of application will eventually prove insufficient or distorted — a hidden fatal anthropomorphic error cannot be excluded. Although such failure at the substantial level of biosemiotics would be realized, Peirce's semeiotic might still remain valuable at the *methodological* level, i.e. if it is applied in the *making* of biosemiotics, and especially, in the formation of its basic theoretical concepts. This aspect of Peirce's philosophy has so far been mostly neglected by biosemioticians. Whatever the best applicable source of basic semiotic concepts is — be it Peirce, Saussure, Bateson, Lotman or others— Peirce's philosophy offers us a method of adjusting them properly. Namely, one of the main purposes of his whole semiotic was to develop methods of *how to make our ideas clear*.[22] Within his Synechism, Peirce accepted that the world in itself contains (or may contain) some real vagueness. This, however, does not mean that we should be satisfied with the usual vagueness of our *conceptions*, but only that there is no inherent exact meanings hidden in our vague ideas — we have no 'clear intuitions' to appeal to. The general purpose of all scientific inquiry is to provide us the definite and well defined scientific concepts that are transparent in both their reference and meaning. How they can be developed from the vague ideas of our mind, how the necessary vagueness of our concepts could be diminished is a task of logical studies, i.e.

of semeiotic. Every new scientific endeavour consists necessarily of mere vague ideas at the beginning and biosemiotics is still at its beginning. The basic semiotic concepts used in biosemiotics are usually far from definite or clear and desperately need some grounding in concrete observations and experiments.

Moreover, besides being relevant (1) in the *making* of biosemiotics, when basic biosemiotic concepts are formed and defined, the understanding of Peirce's methodological principles would be relevant (2) in *understanding Peirce himself*, when the proposed substantial theory of biosemiotics applies concepts with the Peircean origin. Because Peirce is a far from an easy thinker to make sense, it should be more than clarifying to acknowledge what Peirce's own attitude toward his concepts and arguments was. This can be approached by considering how Peirce himself applied his own methodical principles when he composed his concepts and theory.

3. HOW TO MAKE OUR IDEAS CLEAR — PRAGMATICISM

3.1. Pragmatic Maxim as a Definition of Meaning

Peirce called his general methodology for science *pragmatism,* or more specifically, *pragmaticism*.[23] For him, pragmaticism is not a system of philosophy but only a method of thinking (CP 8.206, c.1905), "a method of ascertaining the meanings of hard words and of abstract concepts" (CP 5.464, 1907). The core of pragmaticism is thus merely *a definition of meaning*.

> In order to ascertain the meaning of an intellectual conception one should consider what practical consequences might conceivably result by necessity from the truth of that conception; and the sum of these consequences will constitute the entire meaning of the conception. (CP 5.9, 1907)

This cryptic definition, the *pragmatic maxim,* requires some explications. Firstly, the pragmatic maxim was designed to define *only* the meanings of *intellectual concepts,* i.e. conceptions that are in principle open for somewhat deliberate adoption or rejection (CP 5.467, 1907).

Secondly, Peirce's pragmaticism did not declare that practical utility would be the ultimate value or that the meaning of a conception would be its *realized* practical consequences. Pragmaticism should not be confused with forms of utilitarianism or instrumentalism. The full meaning of a conception is not reducible to any *actual* consequential events, instead, it contains also those possible consequences that *will not* but *would be* actualized if the circumstances were differently.

> Intellectual concepts [. . .] essentially carry some implication concerning the general behaviour either of some conscious being or of some inanimate object, and so convey [. . .] the "would-acts," "would-dos" of habitual behaviour; and no agglomeration of actual happenings can ever completely fill up the meaning of a "would-be." (CP 5.467, 1907).

Thirdly, since the meaning of a concept is not any individual event or thing but a group of certain kinds of 'would-bes', it must be another *conception*, an *anticipative conception* that anticipates or refers to the *possible future effects* of the concept. Moreover, this anticipation is about some 'habitual behaviour', either of *our* action,

or of the action of something else, the habitual behaviour of which *we* can adapt *our* action self-controlledly.[24] This is the meaning of 'practical' in the definition.

Fourthly, all this does not, however, mean that the meaning of a proposition, say, about the big bang would be emptied in its direct practical applications in our life. Quite the opposite, the pragmatic maxim was designed to provide the conception of meaning especially for those intellectual concepts towards which our interest is purely theoretical. Our activity 'to find out', to *make experiments*, is also included in such human conduct, to which a proposition that exposes the meaning is applicable:

> [...] that form of the proposition which is to be taken as its meaning [...] must be simply the general description of all the experimental phenomena which the assertion of the proposition virtually predicts. For an experimental phenomenon is the fact asserted by the proposition that action of a certain description will have a certain kind of experimental result; and experimental results are the only results that can affect human conduct. (CP 5.427, 1905)

3.2. Pragmaticist Biosemiotics

If biosemiotics would meet this criterion for meaningfulness, i.e. if the biosemiotic theory could provide some *experimental results* that no other kind of theory could, that would legitimate the biosemiotic approach in an instant. It may be that this criterion is too demanding for contemporary biosemiotics thus far, but as a guiding goal in developing biosemiotic concepts, it is worth attempting. At least, a simple 'armchair test' of the meaningfulness of the biosemiotic concepts should be made by comparing them with their non-biosemiotic alternatives. Does a biosemiotic explanation or point of view bring anything really differing at the level of experimental testing or of practical applications?

> For the maxim of pragmatism is that a conception can have no logical effect or import differing from that of a second conception except so far as, taken in connection with other conceptions and intentions, it might conceivably modify our practical conduct differently from that second conception. (EP 2:234, 1903)

The main obstacle to making such comparisons is the abstract, vague, and metaphorical character of the mostly used semiotic concepts in biosemiotics. The possible experimental or practical bearings of the concepts of that kind are impossible to be 'conceived' with accuracy. The meanings that they are intended to carry are mere blurry feelings and as such as they are difficult to identify and control. The temptation to speak vaguely is understandable, since it leaves the backdoor open for excuses and corrective additions that would specify —or even construct— the vague or partly unconscious *ad hoc* meaning.

> It is easy to speak with precision upon a general theme. Only, one must commonly surrender all ambition to be certain. It is equally easy to be certain. One has only to be sufficiently vague. (CP 4.237, 1902.)

What can be done in order to make the biosemiotic ideas clearer so that they might be put in an experimental test? In the original formulation of the pragmatic maxim,[25] the intellectual meaning of a concept consists of its 'conceivable practical bearings',

but those 'practical bearings' are the ones of the *object* —i.e. the referent— of the conception. Thus, in order to determine the pragmatic meaning of a scientific concept, to get the better control over its possible *future* products, i.e. over its potential *interpretants*, we need a control over the intended (or assumed) *objects* of the concept too. This hidden demand is underlined in another formulation of the maxim of pragmaticist:

> The elements of every concept enter into logical thought at the gate of perception and make their exit at the gate of purposive action; and whatever cannot show its passports at both those two gates is to be arrested as unauthorized by reason. (EP 2:241, CP 5.212, 1903)

Thus, the control over the *formation* of our concepts constitutes an essential part in the anticipation of its whole pragmatic meaning. Concepts are derived from some kind of *perception* and the circumstances of the observation of that perception may become structured in the concept. The observation plays a double role — scientific concepts are originated by observation and their meaning is dependent on the would-be observation of the would-be results of their would-be experimental testing. For instance, the majority of cognitive (or communicative) concepts are originally based on the observation of some common internal experience of sensing, knowing, understanding, intending, etc. They are nevertheless later abstracted or formalized and, especially in biosemiotics, extended to refer also to such non-human phenomena (like animal cognition) about which we cannot have internal experience. But if the concepts are abstracted without clear awareness about their derivations, some hidden presumptions may have remain in the structure of these concepts, the presumptions that make them not extendable beyond a human sphere. Therefore, scientific concepts cannot be accepted merely as (culturally or intuitively) 'given' — their 'derivations' remain more or less hidden with the consequence that also the meanings of such culturally given everyday concepts remain too vague for scientific use.

The concepts we use even in science are originally vague, but they can be made 'clear and distinct' and one method of achieving this is to analyze the path of the formation of concepts and the observations (or experiences) that are their points of departure. This analysis does not determine the referents of the concepts under scrutiny, they are after all abstracted, but it may *suggest* the possible referents of the concepts, and most of all, exhibit the errors that stay easily hidden.

3.3. Pragmaticism Applied Back to Itself

However, there is one remaining problem, whether Peirce's 'tychastic Synechism' is more than a metaphysical system *a priori.* The differences between Peirce's approach and *a priori* philosophy like Schelling's *Naturphilosophie* or Kant's transcendental idealism can be best illustrated if we apply the pragmatic maxim to Peirce's concepts themselves. We should therefore scrutinise carefully what kind of invisible structural presuppositions are built into his concepts prior to their application to biological theory. This cannot be done properly here (see some details

in Vehkavaara 2006), but some guidelines can nevertheless be given. We can study 1. what kind of *practical bearings* he conceived his logical and metaphysical concepts as having and 2. what kind of *perception* Peirce's derivation of his concepts starts from.

If we consider specifically the pragmatic maxim i.e. the conceivable practical consequences of the pragmatic maxim, Peirce himself characterized pragmatism (in a dictionary article) as being the "opinion that metaphysics is to be largely cleared up by the application of the [pragmatic] maxim for attaining clearness of apprehension" (CP 5.2, 1902). So, the intended practical bearing of the pragmatic maxim itself was to free us from floppy *a priori* metaphysics. It was hoped to wipe them away by showing that endless disputes without any conceivable practical —i.e. *experimental*— differences are senseless.[26] The pragmatic maxim provides quite hard criteria of intellectual meaning especially for metaphysical and logical concepts. The fact that the maxim was originally designed to settle the stubborn nonsensical quarrels of metaphysical and religious doctrines does not, however, limit its potential practical bearings, which Peirce clearly intended to cover all scientific or rational thought. The open question of biosemiotics is, can the pragmatic maxim be applied, extended, or further abstracted so that it could work as a base for *biological meaning* too?

Next we have to ask, in the light of the pragmatic maxim, what kind of perception Peirce's logical and metaphysical concepts are based on and what consequences we can draw from that.

4. CONSEQUENCES OF PRAGMATICISM IN UNDERSTANDING PEIRCE

4.1. Observation in Sciences — Metaphysics is not the 'First Philosophy'

Peirce expressed quite explicitly what kind of perception or experience the elements of philosophical concepts are derived from. He recognized three kinds of observation that separate the three classes of Theoretical science.[27]

1. *Pure mathematics* is based on the observation of *imagined* objects without any guarantee of their application in the actual world. It can describe only the *possible forms* that things (including thought) *may* take in our universe. It is a pure science of *hypotheses* providing no *positive* information about the *actual* reality of our universe. As such it is the *negative science*. (CP 2.782, 1901, CP 1.247, 2.77, 1902.)
2. *Theoretical philosophy* (*Philosophia prima*) draws its conclusions from the observation of *universal phenomena* that "come within the range of every man's normal experience, and for the most part in every waking hour of his life" (CP 1.241, 1902). The findings of philosophy should thus be derivable from *familiar experience* common to everyone.

3. *Special sciences* are based on the *special experience* aided with instruments and other special arrangements and on the analysis of its minute details. Special sciences discover *new* phenomena by expanding the ordinary limits of human experience.[28]

These three classes form a nested hierarchy according to the *abstractness* of the *objects* of study specific to each science (CP 1.180, 1903). All sciences may use the same experiential content as the 'data' for their inquiries, but they *observe* different facts from that 'data', the facts that lead to generalizations at the different levels of abstraction (CP 8.297, 1904). Each special science observes from this 'data' the *special* information peculiar to it — astronomy pays attention to astronomically relevant data, etc. Philosophy observes general information that could in principle have been achieved from any other 'data' too. Because the observed universal experience is present in *any* experience, also in those special experiences which special sciences observe, the familiar every day experience suffices for the observational basis of philosophy. Mathematics, in turn, extracts a mere possible form from the'data', the form the properties of which are in that sense independent on any actually perceived 'data' that merely imagined 'data' would suffice for the source of mathematical inquiries.[29]

The general principle of this hierarchy is that lower sciences rest for their *principles* upon (some of) the higher ones that, in turn, draw their *data* in part from the lower ones and furnish them with applications (EP 2:35, 1898, EP 2:458, 1911, cf. also Kent 1987: 18). The subclasses of each class of Theoretical science inherit this principle. With regard to the two major subclasses of philosophy, Peirce kept logic a more abstract science than metaphysics (EP 2:35–36, 1898). Since metaphysics, the *philosophical science* of the *most general facts of the reality*, is based on the observation of universal experience, it can be asked how such knowledge is possible or whether it is possible at all. On what grounds the correct metaphysics could be argued for, since such knowledge —because of being the most general kind— should be independent on any particular observation or experience and compatible with all possible experience. Peirce followed Immanuel Kant's solution of this problem by rejecting the traditional idea about metaphysics as the 'first philosophy', instead, the basic metaphysical concepts should be applied logical ones (EP 2:30–31, 1898) — i.e. logic is prior to metaphysics. The biosemiotic practice of applying Peirce's logical concepts with a metaphysical tone is thus in principle compatible with Peirce's own application. Nevertheless, such applications are always vulnerable to anthropomorphic errors and excess vagueness.

The independence of logic from metaphysics means that the reality of thought is not a logical question — the science of logic cannot decide whether there is any thought in animals, for instance. The logical concept of sign should be independent of embraced metaphysical principles as well as of the findings of natural sciences, For example, the acceptance of Tychism or Synechism is not required for the acceptance of the Peircean conception of sign. However, the *application* of logical concepts in metaphysics and in biology *is* dependent on embraced metaphysical and biological conceptions. Many (though not all) forms of ontological physicalism, for

instance, are incompatible with all possible applications of Peircean conception of sign. At least some amount of *real* indeterminacy (which does not necessarily mean free will) is required in order to make real sign processes genuinely normative.

The independence of special sciences on logic and metaphysics gives a quite demanding criterion for the generality of philosophical propositions: philosophical generalizations should be in accordance with *all experiential data of all kinds.* Although special sciences cannot provide any *principles* for philosophy, they may provide critique (even if indirect) for philosophical conceptions. The new findings in special sciences may demonstrate that the philosophical concepts derived from familiar experience have not been abstracted enough but that they are after all formulated in unnecessarily concrete or intricate terms (cf. CP 2.75, 1902) — i.e. that they include naturalistic or anthropomorphic errors.

4.2. Transcendental and Objective Perspectives

In the tradition of transcendental philosophy put forward by Immanuel Kant, the concepts of metaphysics are grounded on *transcendental logic*. In Kantian scheme, all our knowledge is admitted to begin with experience, but not so that all of it would arise out of experience. Instead, Kant assumed that

> our empirical knowledge is a compound of that which we receive through impressions, and that which the faculty of cognition supplies from itself (Kant 1781/1787: 1 [B1]).

That part of our knowledge which is in our faculty of cognition itself, must in this Kantian scheme be independent on the empirical or *a posteriori* part, i.e. it is *a priori*, prior to senses. The term *transcendental* refers in the Kantian tradition to concepts focusing on such *a priori* forms of all possible knowledge:

> I apply the term *transcendental* to all knowledge which is not so much occupied with objects as with the mode of our cognition of these objects, so far as this mode of cognition is possible *à priori*. A system of such conceptions would be called *Transcendental philosophy*. (Kant 1781/1787: 15 [B24].)

AQ4

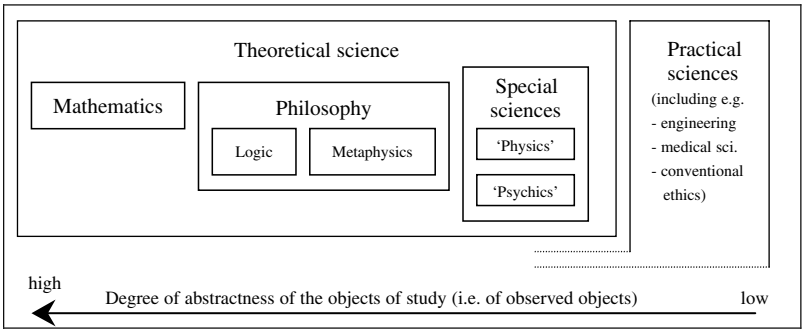

Figure 4. Overview to Peirce's conception about the relations of sciences (before c. 1902)[30]

Peirce's conception about the philosophical observation on which theoretical philosophy is based is an apparent descendant of Kantian conception of transcendental philosophy. The philosophical observation of universal experience *included in any experience* is obvious counterpart for the Kantian idea of transcendental *a priori* form of cognition. Because logic should be derivable from any experience (plus mathematics), i.e. from familiar every day experience, it becomes intimately bound with 'our' perspective and ordinary life. The 'positive facts' that logic can tell us concern the form of our internal epistemic relation with the world we live. This may bring some restrictions on the biosemiotic applicability of Peircean logical concepts.

For instance, the Peirce's original derivation of his concept of sign (CP 1.545–559, 1867) was the construction of the concepts of representamen, object, and interpretant and their irreducible triadic coalition as a sign. The derivation was executed by directing the investigating thought into itself in order to find out *how* it can refer to its object and state something about it. A present thought is directed to observe itself, i.e. directed toward its origin, toward its *object,* to find truth about it, and at the same time, it becomes transformed into another *more self-aware* thought-sign about itself, into its *interpretant*. The interpretant was produced as a means of grasping the true knowledge about the object of thought-sign. Because the interpretant is *constructed* by looking for *truth* about the object, the *aim toward truth* —the logical normativity— is already built in the construction of the triadic structure of sign, no matter how it will be considered or what will be considered in it. This analysis suggests —if it is correct— that Peircean concept of sign may not be as general concept that is often assumed. Consequently, its applicability in biosemiotics is restricted, if it is accepted that the ultimate criterion of goodness for living systems is *survival* or *sufficient fitness* and not so much the truthfulness of their representations. (See more in Vehkavaara 2006.)

However, besides the above described *transcendental perspective*, Peirce employed also a perspective that could be called the *objective perspective*, because within it, a sign is no more considered merely from the perspective of its own, but the whole *chain* of signs, the whole semiosic *process* or succession of signs, is taken as an object of study. The investigating mind is methodically split into the 'observer-mind' and 'observed-mind' so that a present investigating thought in observer's head is no more considered as a part of the object of study. The objective perspective is inevitable for any biosemiotic application of semiotic, because it can be applied to study other minds — it frees us to study and think about non-human minds and non-conscious sign processes. The description of *semiosis* in Chapter 1.2 (see Figure 3) was a description from the objective perspective. The distinction between these two perspectives is essential when Peirce's statements concerning signs are considered. (See more in Vehkavaara 2006.)

Peirce's metaphysics inherits the similar 'transcendental' character from logic. As metaphysics draws its positive content only from the universal features of ordinary experience, the most general facts that it describes must concern their *accessibility* to us, i.e. the form that they 'necessarily' take in *our mind* (independently on their

more concrete content). For instance, in his paper "Evolutionary Love" (EP 1:352–371, 1893), Peirce demonstrates there being two other kinds of evolution besides a tychastic one by fortuitous variation. The other two were *anancastic* evolution by mechanical necessity and *agapastic* evolution by 'evolutionary love' i.e. by force of a self-organizing habit. They were all considered as real powers in the world but they are, however, only three *possible forms* that real processes *may* take, three real possibilities that should not be excluded *a priori* when some specific real process is investigated. Whether or not an individual process (be it chemical, geological, celestial, phylogenetic, epigenetic, metabolic, psycho-dynamic, communicative, etc.) is dominated by 'creative love', for instance, is not properly a metaphysical quarrel. It is dependent on the observation of the appropriate *special* phenomenon and therefore belongs under the corresponding special science.

4.3. Fallibilism — Transcendental but not *a Priori*

Although Peirce's conception about philosophical observation gives to his philosophy a kind of 'transcendental flavour' that even the adoption of objective perspective cannot completely strike out, it is nevertheless not transcendental *a priori*. Whereas for Kant the *a priori* conditions of cognition have to be undeniable "with the full guarantee for validity" (Kant 1781/1787: 16), for Peirce, the philosophical observation is by no means infallible although its pitfalls are different than what special sciences face.[31] Because *all* sciences and *all rational thought* is based on the observation of some kind of perception, there are strictly speaking no *a priori* concepts at all, no concepts 'prior to senses'. For Peirce, there is no pure knowledge *a priori*, i.e. no purely *a priori* certain knowledge in a Kantian sense,

AQ5

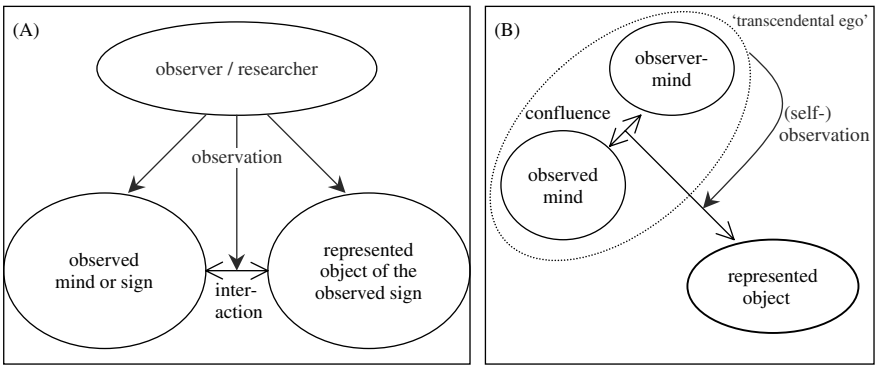

Figure 5. Observation from the objective perspective (A), and from the transcendental perspective (B)

because there is no such knowledge with which "no empirical element is mixed up" (Kant 1781/1787: 2).[32]

With this assumption about the observational origin of all the elements of knowledge, Peirce breaks with the mainstream of modern philosophy. Namely, Peirce argues that no absolute infallibility or certainty is accessible in *any* human endeavour.[33] The fallibility of human sensations is widely accepted (and experientially supported), but it is quite rare in the philosophy of western tradition that this fallibilism is extended even into mathematics.[34] If even mathematics is accepted as fallible without any commitment to nihilism or extreme scepticism, then philosophy, i.e. logic and metaphysics, certainly follows. Peirce did not expect that internal senses, on which mathematics, philosophy and, parts of the psychical special sciences lean, would provide any more epistemically privileged information than external senses. Inconceivability, unimaginability, or indubitability, which are often appealed to when rationalistic *a priori* doctrines are tried to justify, are historically proven to be far from infallible.

> But that which has been inconceivable today has often turned out indisputable on the morrow. Inability to conceive is only a stage through which every man must pass in regard to a number of beliefs [...]. His understanding is enslaved to some blind compulsion which a vigorous mind is pretty sure soon to cast off. (CP 6.49, 1892)

The task of philosophy is not to dwell on infallible truths or any other *a priori* certain foundation for scientific knowledge. It would be a grave error to read Peirce as if he would aim to provide a foundational basis of science, a new foundation upon which the house of the new science would be built. Throughout his scientific career, Peirce opposed such a Cartesian dream about the absolutely certain foundation of knowledge that has been governing modern philosophy at least since the days of Descartes (e.g. CP 5.264–265, 1868). Instead, he called his attitude toward philosophy a 'laboratory-philosophy' contrasting it with the philosophies of 'theological seminaries' (CP 1.129, 1905) referring especially to Hegel and Schelling, the major representatives of idealistic *Naturphilosophie*.

> [M]y attitude was always that of a dweller in a laboratory, eager only to learn what I did not yet know, and not that of philosophers bred in theological seminaries, whose ruling impulse is to teach what they hold to be infallibly true. (CP 1.4, 1897)

Peirce describes his attitude of 'laboratory-philosophy' as follows:

> Thus, in brief, my philosophy may be described as the attempt of a physicist to make such conjecture as to the constitution of the universe as the methods of science may permit, with the aid of all that has been done by previous philosophers. I shall support my propositions by such arguments as I can. Demonstrative proof is not to be thought of. The demonstrations of the metaphysicians are all moonshine. The best that can be done is to supply a hypothesis, not devoid of all likelihood, in the general line of growth of scientific ideas, and capable of being verified or refuted by future observers. (CP 1.7, 1897)

Despite all his rejection of *a priori* knowledge, encouragement to 'laboratory-philosophy', and mocking of the philosophies of 'theological seminaries', Peirce nevertheless appreciated some of the *results* of the great German Idealists: Kant, Hegel, and Schelling (CP 1.21, 1903). However, even if their *a priori* method of reasoning would produce some valid conclusions, such success would more or less be due to an accident — Peirce could not see much sense in the argumentation by which they reasoned to obtain these results. Such *a priori* method does not provide tenable means to distinguish the apparent errors that they include from the valid conclusions. Moreover, their aim or longing to provide some *a priori* certain foundation for science leads to an understandable but harmful habit of giving an infallible status to such *a priori* results, i.e. removing them outside of the target area of inquiry.

For Peirce, the *results* do not make a science but the *way they are produced*, and this applies to logic and metaphysics too. Perhaps the most important lesson that biosemioticians should learn from Peirce is his attitude toward science, science that includes also metaphysics and semiotic. It is the attitude of potential impermanence of all the scientific results that we ever can derive, the attitude that emphasizes the making our scientific concepts and ideas clearer and clearer, i.e. that their pragmatic meaning and conceptual structure would be better and better exposed. It is the attitude that whatever our embraced logical and metaphysical principles are, they are not *believed* and taken as the premises of our inquiry but they are considered as *hypotheses* that have to be argued for instead. For Peirce, beliefs should have no role in scientific argumentation, except as a *source* of *hypotheses* but as such, they are strictly speaking no more fully believed. All convictions and beliefs are judged by Peirce as harmful in science:

> I hold that what is properly and usually called *belief* [...] has no place in science at all. We *believe* the proposition we are ready to act upon. [...] But pure science has nothing at all to do with *action*. The propositions it accepts, it merely writes in the list of premisses it proposes to use [...] and the whole list is provisional. The scientific man is not in the least wedded to his conclusions. He risks nothing upon them. He stands ready to abandon one or all as soon as experience opposes them. Some of them, I grant, he is in the habit of calling *established truths*; but that merely means propositions to which no competent man today demurs. [...] Still, it may be refuted tomorrow; and if so, the scientific man will be glad to have got rid of an error. There is thus no proposition at all in science which answers to the conception of belief. (CP 1.635, 1898.)[35]

The pure scientific attitude that Peirce forcefully expounded is that we should not allow some general world view based on our more or less uncontrolled impressions[36] and 'seemings' dictate what kind of explanations, descriptions, and concepts are in principle acceptable in science. That attitude, if applied to the *making* of biosemiotics, would eventually make it a science.

ACKNOWLEDGEMENTS

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NOTES

[1] Michael Bradie has distinguished two interrelated but distinct programs which both go by the name 'evolutionary epistemology'. 'EET' is an abbreviation of the 'evolutionary epistemology of theories', which "attempts to account for the evolution of ideas, scientific theories and culture in general by using models and metaphors drawn from evolutionary biology." 'EEM', the 'evolutionary epistemology of mechanisms' in turn, attempts "to account for the characteristics of cognitive mechanisms in animals and humans by a straight-forward extension of the biological theory of evolution to those aspects or traits of animals which are the biological substrates of cognitive activity, e.g., their brains, sensory systems, motor systems, etc." (Bradie 1986: 403.)

[2] More properly, the explanatory principle in evolutionary epistemology is the general *selection theory* that is abstracted from the principle of natural selection (Campbell 1997: 7).

[3] In Vehkavaara (2002), I suggested a method of *semiotic naturalism* that would minimize the risk to fall on these fallacies.

[4] Peirce is not the only source of the semiotic ideas of this school of biosemiotics. Jakob von Uexküll and Gregory Bateson have obviously been just as influential as Peirce and some concepts have been borrowed from the cultural semiotics of Juri Lotman (like 'semiosphere').

[5] The term 'semiotic' here refers to the overall field of discourse or discipline that concerns signs. 'Semeiotic' and 'Semiology' are used to refer to Peirce's and Saussure's particular semiotic theories.

[6] The emphasis on sign-action dominated Peirce's later and more mature views on sign and semiosis. However, especially in his early papers (most notably in "On a New List of Categories", CP 1.545-559, 1867), the concept of sign was viewed and derived as a kind of transcendental concept which can hardly be interpreted as a dynamic one. (cf. Vehkavaara 2006). About the distinction between *sign-object* and *sign-action* see e.g. Deledalle (2000: 38–39).

[7] The object of a sign does not have to be any concrete particle or other material thing — it can be anything (a material thing, perception, idea, lawful behavior of nature, dream, etc.) which excites the mind to search some better or fuller representation of it. However, this requires that the object is somehow beforehand, by some *collateral observation*, acquainted — the sign cannot provide the sole access to the object (cf. EP 2:408-9,429, 1907). Still, the sign does not necessarily only draw the interpreter's attention to the object, but that it may also provide some *new* information about the object.

[8] The conception of a *belief* as a deliberate or partly conscious habit of action is one of the core conceptions in pragmatism (cf. CP 5.12, 1907). "A belief in a proposition is a controlled and contented habit of acting in ways that will be productive of desired results only if the proposition is true." (EP 2:312, 1904)

[9] See especially Artmann (in this volume) and also Barbieri (2002) on Morse code and his organic meaning.

[10] This intimate participation in the science of his time influenced greatly both his conception of science and the content of his philosophy. Peirce's metaphysics took its inspiration —besides from modern logic and mathematics— from the latest achievements of the natural sciences of the 19th century. The most important of these were Kirchoff's Spectroscopy in 1859, Mendeleev's Periodic Table in 1852, Rankine's, Clausius', and Kelvin's thermodynamics from 1850 onward, Pasteur's findings in microbiology from 1848 onward, and the most of all, Darwin's natural selection in 1859.

[11] "There is a mathematical logic, just as there is a mathematical optics and a mathematical economics. Mathematical logic is formal logic. Formal logic, however developed, is mathematics. Formal logic, however, is by no means the whole of logic, or even its principal part. It is hardly to be reckoned as a part of logic proper." (CP 4.240, 1902.) However, in 'logic proper' Peirce included both epistemology (*Speculative grammar*, "the general theory of the nature and meanings of signs") and general methodology (*Methodeutic* or *Speculative rhetoric*, "which studies the methods that ought to be pursued in the investigation") along with *Logical Critic*, logic in narrow sense, "which classifies arguments and determines the validity and degree of force of each kind" (EP 2:260, 1903, CP 2.206–207, 1901).

[12] Peirce used the term 'logic' as the *name* of the logical science and *not* to refer to its *object of study* which is another common use of the term 'logic' (e.g. in phrases 'women's logic' or 'logic of the

universe'). Logic in this latter meaning is, especially if considered as a *description* of a *real* phenomenon, rather a question of metaphysics or psychical sciences than of logical science.

[13] This is Peirce's solution to the problem that thought is, in itself, quite an abstract and vague concept, which is hard to grasp because of its internal, immaterial, temporary, and flexible characters. The 20th century western philosophy, almost every branch of it, has tried to solve this problem in another way, by making a 'linguistic turn', by considering only linguistically expressible thoughts and language as *the* medium of thought. Structuralism based on Saussure's semiological vision is a one form of it.

[14] See Hoffmeyer (1993: 25–27) and Brier (2003: 74). These insights have not necessarily been adopted straight from Peirce's writings but some of them might have been already adopted from other sources (e.g., Gregory Bateson) and Peirce's writings are just found to appear as compatible with them.

[15] It can be argued that logic of science was not only Peirce's starting point (or *motive*) but also one of his main *purposes* of his theory (cf. Vehkavaara 2006).

[16] One of the central characteristic of Peirce's metaphysics is his strong 'three category realism' or "extreme scholastic realism" (CP 8.208, c.1905). This consists of the acceptance that not only singular existent events are real, but that also possibilities and *some* general objects (like laws and habits) are real. This does not mean that *all* generals were real since, according to Peirce, nobody ever thought that "but the scholastics used to assume that generals were real when they had hardly any, or quite no, experiential evidence to support their assumption; and their fault lay just there, and not in holding that generals could be real" (EP 2:342, 1905). The counterpart to 'real' is not 'ideal' but 'figment' or 'illusion': "A figment is a product of somebody's imagination; it has such characters as his thought impresses upon it. That those characters are independent of how you or I think is an external reality. […] Thus we may define the real as that whose characters are independent of what anybody may think them to be." (EP1:136, 1878) This, in turn, does not mean that what is relative to thought cannot be real. "*Red* is relative to sight, but the fact that this or that is in that relation to vision that we call being red is not *itself* relative to sight; it is a real fact" (EP 2:343, 1905).

[17] According to Synechism, we must not say

- "that the sum of the angles of a triangle exactly equals two right angles, but only that it equals that quantity plus or minus some quantity which is excessively small for all the triangles we can measure"
- "that phenomena are perfectly regular, but only that the degree of their regularity is very high indeed"
- "being is, and not-being is nothing." like Parmenides but "that being is a matter of more or less"
- "I am altogether myself, and not at all you," i.e. "synechism recognizes that the carnal consciousness is but a small part of the man. There is, in the second place, the social consciousness, by which a man's spirit is embodied in others, and which continues to live and breathe and have its being very much longer than superficial observers think." (CP 7.568–575, 1892.)

[18] Peirce viewed Darwinian evolution as an example of *tychastic* evolution. The other possible types of evolution considered by Peirce were *anancastic* evolution by mechanical necessity and *agapastic* evolution by 'evolutionary love' i.e. by force of a self-organizing habit. Lamarckian evolution was Peirce's example of agapastic evolution. (See more later, and in CP 6.300–302, 1893.)

[19] "[A]n explanation should tell *how* a thing is done, and to assert a perpetual miracle seems to be an abandonment of all hope of doing that, without sufficient justification" (CP 2.690, 1878).

[20] "[B]y supposing the rigid exactitude of causation to yield, I care not how little — be it but by a strictly infinitesimal amount — we gain room to insert mind into our scheme, and to put it into the place where it is needed" (CP 6.61, 1892).

[21] Peirce himself defines the most abstract sense of 'mind' as following: "Mind has its universal mode of action, namely, by final causation. The microscopist looks to see whether the motions of a little creature show any purpose. If so, there is mind there." (CP 1.269, 1902.) The general abstracted concept of mind or thought do not contain any assumption of its self-consciousness or of free will though Peirce by no means rejects the real possibility of self-conscious mind equipped with free will: "Thought is often supposed to be something in consciousness; but on the contrary, it is impossible ever actually to be directly conscious of thought. It is something to which consciousness will conform, as a writing may conform it. Thought is rather of the nature of a habit, which determines the suchness of that which may come into existence, when it does come into existence." (EP 2:269, 1903.)

[22] "How To Make Our Ideas Clear" is the title of his perhaps best known paper (CP 5.388–410, 1878). In it, the principle of pragmaticism occurs the first time as presented (though the words 'pragmatism or pragmaticism do not occur).

[23] The idea of pragmatism was developed in early 1870's, in the conversations of the 'Metaphysical Club', a small group of young Cambridge philosophers (and lawyers) lead by Peirce, William James, and Chauncey Wright. It was not until 1898 when James, Peirce's life long friend and both philosophical and financial supporter in the last years of his life, first brought the term 'pragmatism' before the public, which led to the tremendous popularisation of pragmatism around the turn of the century. Although Peirce was probably the originator of the basic idea of pragmatism, Peirce and his pragmaticism (renamed in 1904, in order to be safe from 'kidnappers', cf. CP 8.194, 5.414) was hardly known at all. The leading pragmatists, James and John Dewey, nevertheless gave the honour to Peirce as the originator of it, though even Peirce hesitated whether it was him or James who first used the term 'pragmatism' (CP 8.253, 1900).

[24] "The meaning of a proposition is itself a proposition. Indeed, [...] it is a translation of it. But of the myriads of forms into which a proposition may be translated, what is that one which is to be called its very meaning? It is, according to the pragmaticist, that form in which the proposition becomes applicable to human conduct, not in these or those special circumstances, [...] but that form which is most directly applicable to self-control under every situation, and to every purpose. This is why he locates the meaning in future time; for future conduct is the only conduct that is subject to self-control." (CP 5.427, 1905)

[25] The first written description about the pragmatic maxim was published in 1878: "Consider what effects, that might conceivably have practical bearings, we conceive the object of our conception to have. Then, our conception of these effects is the whole of our conception of the object." (CP 5.402, 1878.)

[26] "Pragmaticism, then, is a theory of logical analysis, or true definition; and its merits are greatest in its application to the highest metaphysical conceptions." (CP 6.490, 1910)

[27] Peirce's main scientific interest and attention concentrated on what he called Theoretical science. Theoretical science differs from Practical sciences according to the most general end of inquiry, the end that functions as an ultimate criterion for the successfulness of the inquiry. Theoretical science is ultimately guided and valued by the *intrinsic* end of inquiry, truth, while practical sciences are guided by various practical ends, *extrinsic* for the inquiry. Theoretical science has two subbranches *Heuretic Sciences* or *Sciences of Discovery* and *Science of Review* or *Retrospective Science*. Mathematics, Philosophy, and Special sciences are the three classes of Heuretic Science. Wheras Heuretic Science is studying 'directly' the phenomena, the Retrospective Science is studying phenomena mediately, collecting and uniting the results of different Heuretic Sciences. Thus, *Synthetic Philosophy* represented by Alexander Humboldt's *Cosmos*, Auguste Comte's *Philosophie positive*, and Herbert Spencer's *Synthetic Philosophy* are classified under the Science of Review. In addition, all considerations that relate different sciences in general, e.g. histories and classifications of sciences belong under the branch of Science of Review. Peirce named synthetic philosophy as *Philosophia ultima* in order to make difference with *Philosophia prima*, the theoretical philosophy of Heuretic Sciences (EP 2:372–373, 1906).

[28] The special sciences consist of two subclasses, physical and psychical. The difference between physical and psychical special sciences is that 'physics' sets forth the workings of efficient causation and 'psychics' of final causation (CP 1.242, 1902). Physical and psychical phenomena are not independent on each other since Peirce did not see final and efficient causation as alternatives, but some chain of efficient causes is always involved in any event guided by a final cause (cf. CP 1.212, 1902).

[29] Thus, every science has its mathematical part, but that part alone studies such forms from which all concrete elements and references to the reality of the actual world are abstracted away (CP 1.133, 1894).

[30] Before the first years of 20th century, Peirce recognized only two subdisciplines of theoretical philosophy, logic and metaphysics, but in 1901-1902, Peirce's conception about the philosophical science deepened. He found out that theoretical philosophy actually contains a couple of other sciences that he previously had not recognized it containing. According to this new conception, theoretical philosophy divides into three subdisciplines, to *phenomenology* (later also *phaneroscopy*), *normative sciences,* and *metaphysics*. Normative sciences divide further into three: to *esthetics*, *ethics* (renamed later as *practics*), and *logic* (or *formal semeiotic*).

[31] "[…] the observational part of philosophy is a simple business, compared, for example, with that of anatomy or biography, or any other special science.
To assume, however, that the observational part of philosophy, because it is not particularly laborious, is therefore easy, is a dreadful mistake, into which the student is very apt to fall, and which gives the death-blow to any possibility of his success in this study. It is, on the contrary, extremely difficult to bring our attention to elements of experience which are continually present. For we have nothing in experience with which to contrast them; and without contrast, they cannot excite our attention." (CP 1.133–134, 1894.)

[32] This rejection (or doubt) of the reasonableness of the whole conception about *a priori* can be seen in Peirce's critique of Kant's starting point:
"Immanuel Kant asked the question, "How are synthetical judgments *a priori* possible?" […] By *a priori* judgments he meant such as that all outward objects are in space, every event has a cause, etc., propositions which according to him can never be inferred from experience. […] But before asking *that* question he ought to have asked the more general one, "How are any synthetical judgments at all possible?" How is it that a man can observe one fact and straightway pronounce judgment concerning another different fact not involved in the first?" (CP 2.690, 1877.)
This latter question was Peirce's starting point in the original derivation of the concept of sign (CP 1.545–559, 1867).

[33] "Though infallibility in scientific matters seems to me irresistibly comical, I should be in a sad way if I could not retain a high respect for those who lay claim to it, for they comprise the greater part of the people who have any conversation at all. When I say they lay claim to it, I mean they assume the functions of it quite naturally and unconsciously. The full meaning of the adage *Humanum est errare*, they have never waked up to. In those sciences of measurement which are the least subject to error — metrology, geodesy, and metrical astronomy — no man of self-respect ever now states his result, without affixing to it its *probable error*; and if this practice is not followed in other sciences it is because in those the probable errors are too vast to be estimated." (CP 1.9, c.1897)

[34] "Theoretically, I grant you, there is no possibility of error in necessary reasoning. But to speak thus "theoretically," is to use language in a Pickwickian sense. In practice, and in fact, mathematics is not exempt from that liability to error that affects everything that man does. […] The certainty of mathematical reasoning, however, lies in this, that once an error is suspected, the whole world is speedily in accord about it." (CP 5.577, 1898)

[35] On the other hand, beliefs are far from forbidden for a scientist, quite contrary, they are *indispensable* in his/her practical life. Even scientists have to cope with the life world of his/her own and in practical decisions everyone should rely more on his/her instincts and beliefs rather than reason. Especially in matters of vital importance, it would be *unwise* to rely chiefly on reason — reason is too slow and fallible in practice if compared with instincts (no matter whether being culturally or biologically fixed) that are tested in practice by past generations. (CP 1.633–639, 1898.)
"Here we are in this workaday world, little creatures, mere cells in a social organism itself a poor and little thing enough, and we must look to see what little and definite task our circumstances have set before our little strength to do. The performance of that task will require us to draw upon all our powers, reason included. And in the doing of it we should chiefly depend not upon that department of the soul which is most superficial and fallible — I mean our reason — but upon that department that is deep and sure — which is instinct." (CP 1.647, 1898)

[36] The high standards of validity that Peirce gave to the philosophical science is underlined by the modesty with which Peirce judged his own vocation to logic: Peirce claimed that he would not have achieved much scientific results about signs, but that most of his propositions were based only on "a strong impression due to a life-long study of signs" (EP 2:413, 1907). Three years before his death, he still denied having tenable grounds for his "sundry universal propositions concerning signs" (EP 2:462, 1911). It is the insufficient amount of *rational self-control* that makes impressions, even if based on life-long study and even if correct, not enough for true science. Impressions are derived directly from intuitive feelings and the estimation of their validity is beyond rational self-control. Impressions of a scientist are good only for hypotheses, but any claim or *belief* about their validity *because* they are 'due to life-long study' do not belong to science.

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